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The influence of climatic factors on the elemental composition of *Feteasca regala* wine from three southern regions of Romania

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INTRODUCTION

This paper aims to the aromatic investigation of the Fetească regală wine, manufactured in 2019, from three established centers in Romania: Samburesti, Corcova and Avincis Dragasani. After liquid/liquid extraction, the aromatic composition was identified and quantified by gas chromatography coupled with mass spectrometry (GC-MS). 42 aroma compounds were determined and were analyzed depending on the region of origin of the vineyards and climatic factors. Results showed significant differences regarding the wines origin regions. High alcohols vary between 28644.5354 µg/L and 33969.2714 µg/L and esters between 4221.1000 µg/L and 7901.2540 µg/L. Significant values were determined for the fatty acids that ranged between 5310.9901 µg/L and 6045.1500 µg/L and lactones presented values between 727.39 µg/L and 988.01 µg/L. The most significant results regarding the aroma profile were determined for the wine from Avincis Dragasani vinery, where the climatic indicators ratio was optimum, thus conferring specific and quantifiable elements to the wine.

Fig. 1 The representation of the studied wine centers from Romania

MATERIALS AND METHODS

The samples analyzed were 2019 production Feteasca regala wines from three wine centers from Romania, Valcea county, namely: Samburesti (44º 48′ N 24º23′ E), Corcova (44°41′ N 23° E) and Avincis Dragasani (44°39′ N 24°15′ E) as illustrated in figure 1.

The soils in the three studied areas are reddish-brown, pozdolite, mostly loamy-clayey, slightly eroded on slopes, alternately calcareous, rich in mineral elements, which influences the accumulation of volatile compounds.

Sample preparation

100 mL of wine sample were extracted 3 times with dichloromethane (10 mL, 10 mL, and 5 mL) for 15 minutes at 700 rpm. The organic extract was dried on anhydrous sodium sulfate, concentrated up to 1.0 mL and analyzed.

GC-MS analysis

The analysis of the minor volatile compounds from the wine samples was performed by using a gas chromatograph (GC) coupled with a mass spectrometer (MS) Varian 450-GC with Varian 240-MS equipment. The GC was equipped with a Thermo Scientific TG-WAXMS (60 m x 0,32 mm, 0,25µm film thickness) capillary column. The carrier gas was helium at a flow of 1.2 mL/min and a splitting injection system was used. The injection volume was 1µL. The column temperature was programed as follows: 35℃ for 2.8 min., then it increases up to 120℃ with 4℃/min. for 4 min., ramped up to 190℃ with 10℃/min. mentained for 7 min. The mass detector was used at 70 eV in the scan mode, and the mass range for ion scan was between 40 and 300 m/z (mass to charge ratio).

PCA was applied to the matrix formed by the total minor volatile compounds corresponding to all of the different wine samples.

RESULTS AND DISSCUSION

The maximum number of PCs was set at three; however, the first two components explained all of the data variance (63.2% and 36.8%), as shown in the score plot in figure 9. The PCA score plots of evaluated volatile compounds showed the best separation of points for Feteasca Regala wine originating from three different vineyards located in the same area.

After taking into account the Kaiser-Meyer-Olkin selected components, the performed PCA analysis revealed that the first two components explained 100% of the total variation. The first principal component (PC1) explained 78.9% of the total variance and presented a high negative correlation with most of the ester group, separating Sâmburești region from Corcova. PC2 explained 21.1% of the total variance and separated Avincis Drăgășani area from the other and mostly corresponded to the oenoclimatic aptitude index and viticultural bioclimatic index. Multivariate statistical methods were essentially useful to reduce a large number of correlated variables into a small number of uncorrelated vectors, allowing a clearer graphical representation. Therefore, the attempt to eliminate the elements in order to define better the variables responsible for origin separation was made, but the percentage of explained variance remained the same. The wine volatile profile and climatic factors along with chemometric analysis methods successfully differentiate the geographical locations. Even if the provenance regions were close in distance, each of them has their own particularities in terms on pedoclimate offering to the same variety unique features

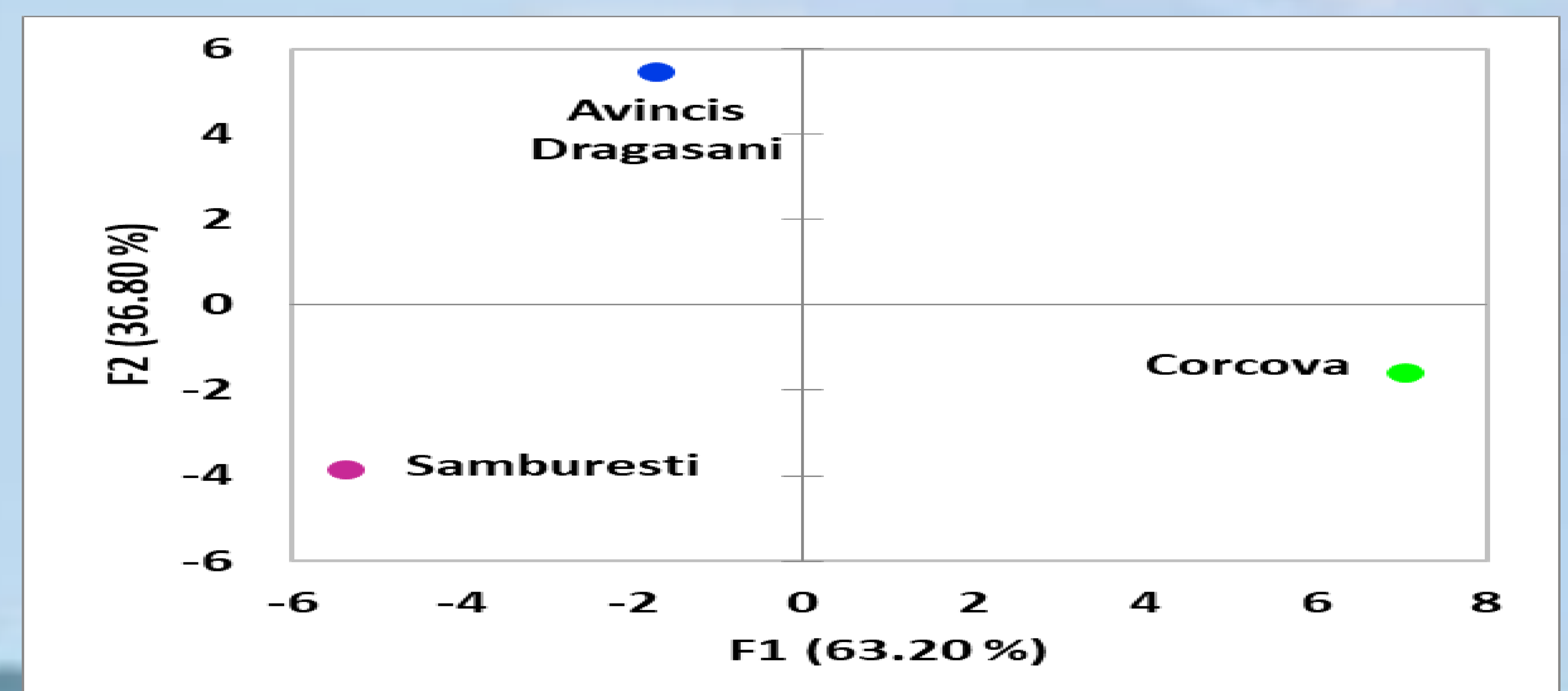

Figure 9. PCA score plot of the total minor compounds by geographical origin of Feteasca Regala wine

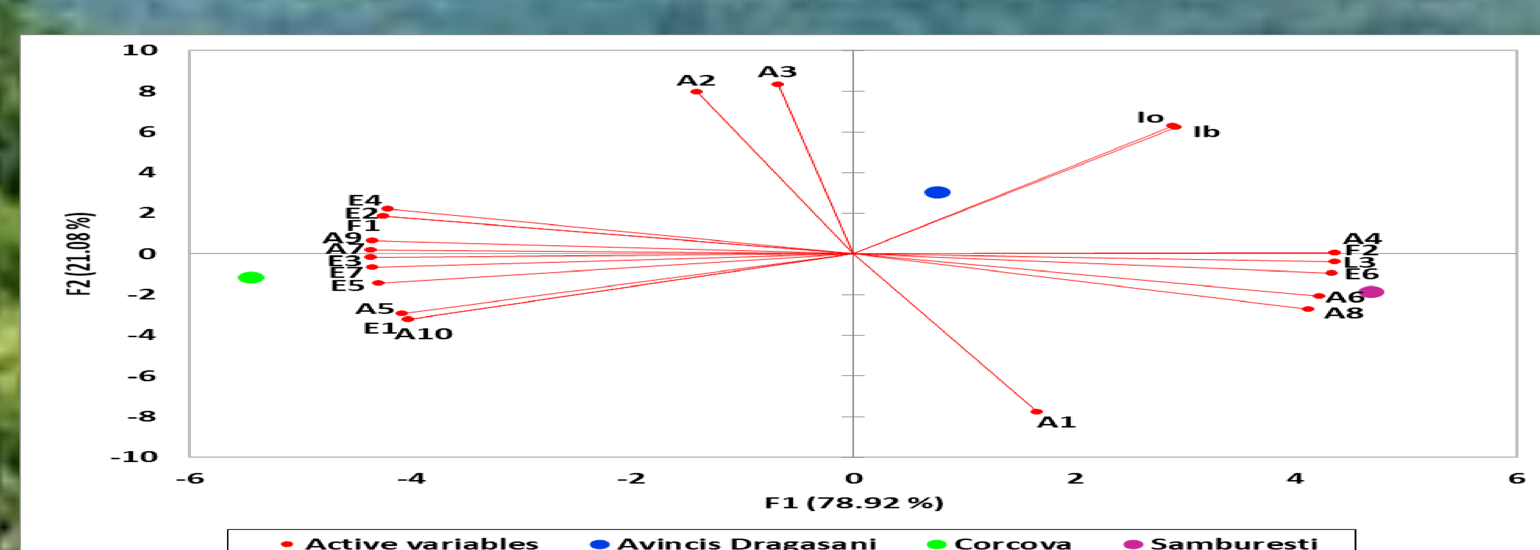

Figure 10. PCA score plot using Kaiser-Meyer-Olkin determined variables at an accepted level of significance of α = 0.60 (Io - oenoclimatic aptitude index; Ib - viticultural bioclimatic index; A1 – iso butanol; A2 – 2-nonanol; A3 – Terpineol; A4 – 1-Hexanol; A5 – 4-methyl-1-pentanol; A6 – E-3-hexenol; A7 – Linalool; A8 – Glycerin; A9 – Benzyl alcohol; A10 – 3-hydroxy-butanone; E1 – Hexyl-acetate; E2 – Ethyl octanoate; E3 – Ethyl-3-hydroxy butyrate; E4 – Ethyl decanoate; E5 – Ethyl hydrogen succinate; E6 – Phenethyl acetate; E7 – Methyl-4-hydroxy-butanoate; F1 – Decanoic acid; F2 – 2-Oxoadipic acid and L3 – Butyrolactone)

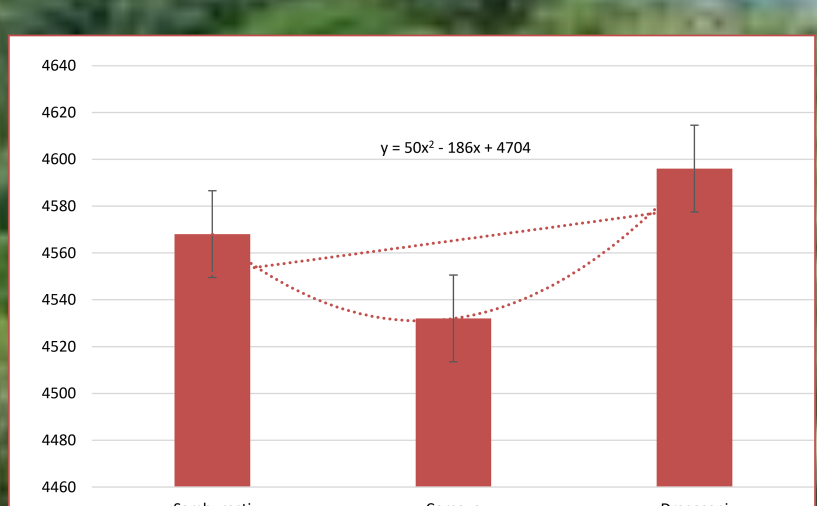

Fig 2. The oenoclimatic aptitude index calculated for the year 2019 for the investigated regions of origin of the Feteasca regala wine samples

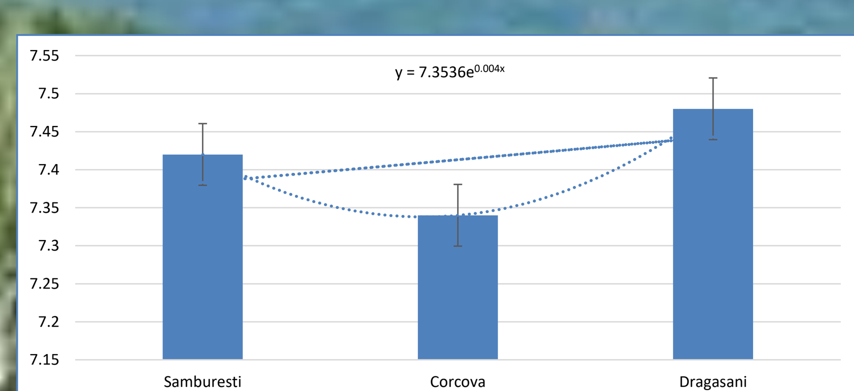

Fig 3. The viticultural bioclimatic index calculated for the year 2019 for the investigated regions of origin of the Feteasca regala wine samples

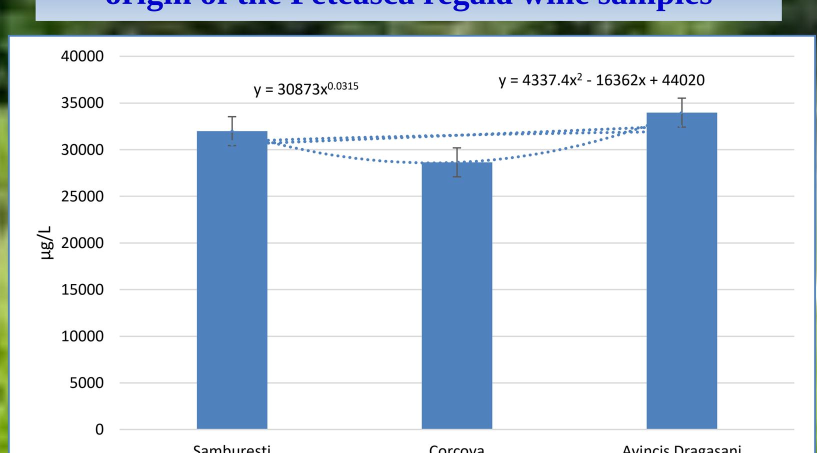

Fig 4. The variation of the total higher alcohols from the wine samples analyzed

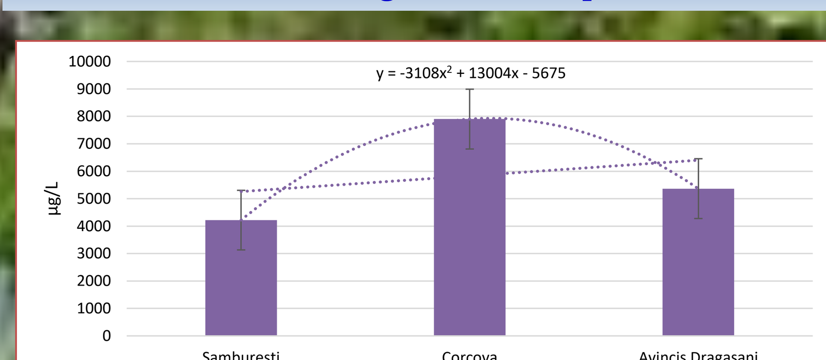

Fig 5. The variation of the total esters from the wine samples analyzed

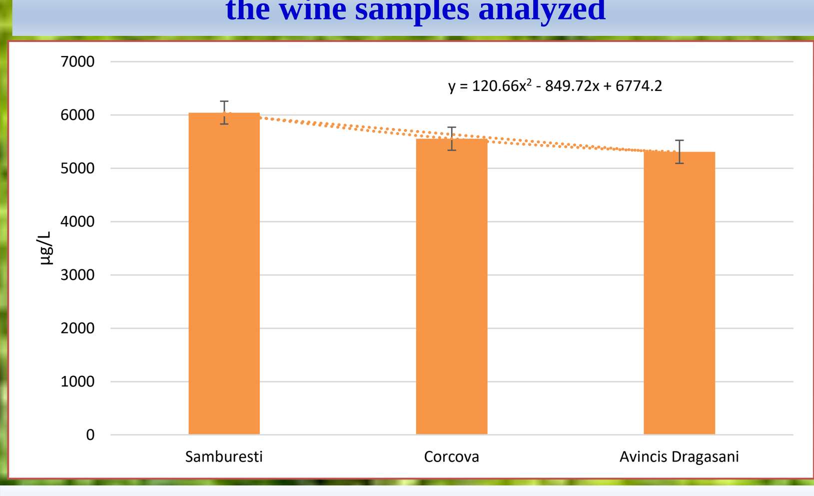

Fig 6. The variation of the total fatty acids from the wine samples analyzed

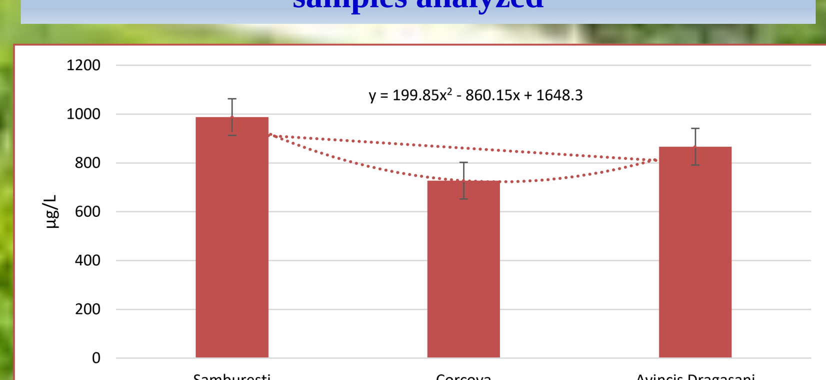

Fig 7. The variation of the total lactones from the wine samples analyzed

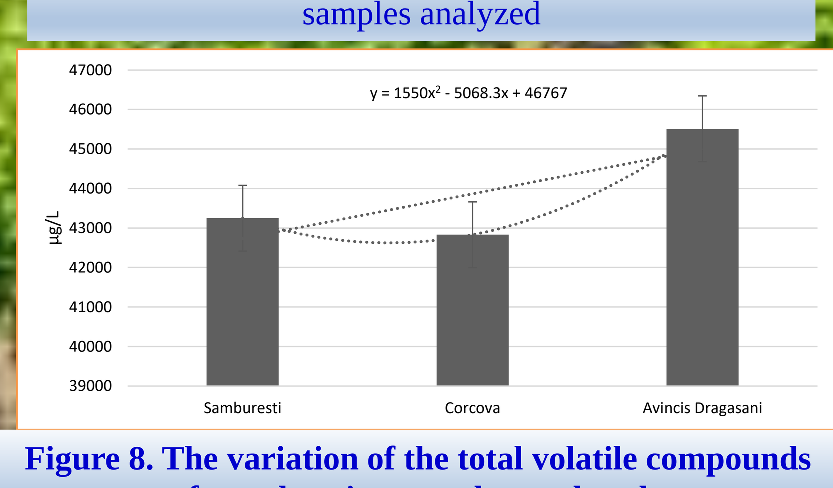

Figure 8. The variation of the total volatile compounds from the wine samples analyzed

CONCLUSIONS

Following the evolution of aroma compounds in the wine samples analyzed, the highest amounts were determined for wines obtained from grapes harvested from vineyards that were situated on brown or brown-reddish soils, rich in limestone and located on alluvial gravels, where the oenoclimatic aptitude index and the viticultural bioclimatic index were high. This was possible in the Dragasani region, the results obtained being superior to those in Samburesti and Corcova regions. These indicators have led to a more significant accumulation of higher alcohols. A slightly lower pedoclimatic index was reported in the Samburesti region where aroma compounds such as higher alcohols and esters showed amounts below those of Dragasani region. These values can also be influenced by soils that have a different configuration: clayey, loamy-clayey. Instead, crops that are oriented on the southern, south-eastern and south-western slopes lead to the accumulation of volatile compounds such as fatty acids and lactones at significantly higher values than Dragasani and Corcova regions. The lowest values of the calculated climatic indexes were in the Corcova region (about 10-12%), although the soil has favorable properties for growing vines (reddish-brown with leached chernozems, medium texture, locally coarse or clay-loam). These qualities have led to wines with a rich ester content which gives them specific aromas and bouquet.

In perspective of the outcomes achieved inside this preliminary investigation, it can be concluded that a classification approach based on the combination of volatile profile and climatic factors, together with appropriate chemometric techniques is a promising and effective way for differentiating Fetească Regală wine variety conforming to their geographical origin. The analyzed wines surprised only a segment of the multitude of factors that lead to the formation of the aromatic palette of a wine, but as it is observed for the same variety volatile compounds can accumulate in variable amounts contributing to the formation of their sensory properties.

Acknowledgements

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